GEJ-3837A

OPERATING MANUAL

DIESEL-ELECTRIC LOCOMOTIVE

GENERAL ELECTRIC

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GENERAL ELECTRIC DIESEL-ELECTRIC LOCOMOTIVE

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Do not order parts from plates in this publication.

GENERAL ELECTRIC

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GENERAL DATA

MODEL	U28B	U28C
HORSEPOWER	2800	2800
TYPE (AAR SYMBOL)	B-B	C-C
MAJOR DIMENSIONS		
Over-all Length Inside Knuckles	60 ft 2 in.	67 ft 3 in.
Over-all Width	10 ft 3 1/4 in.	10 ft 3 1/4 in.
Over-all Height Above Rail	14 ft 9 in.	15 ft 4 1/4 in.
Length between Center Plates	36 ft 2 in.	41 ft 7 in.
Total Wheel Base	45 ft 6 in.	49 ft 10 in.
Truck Wheel Base	9 ft 4 in.	13 ft
DRIVE		
Traction Motors	Four GE-752	Six GE-752
Wheel Diameter	40 in.	40 in.
WEIGHT (TYPICAL)		
Total Weight	252,000 lb	360,000 lb
Total on Drivers	252,000 lb	360,000 lb
Per Axle	63,000 lb	60,000 lb
SUPPLIES		
Fuel	1700 gal	3000 gal
Lubricating Oil	380 gal	380 gal
Cooling Water	300 gal	300 gal
Governor Oil	2 qt	2 qt
Sand	48 cu ft	48 cu ft
AIR BRAKES	26L	26L

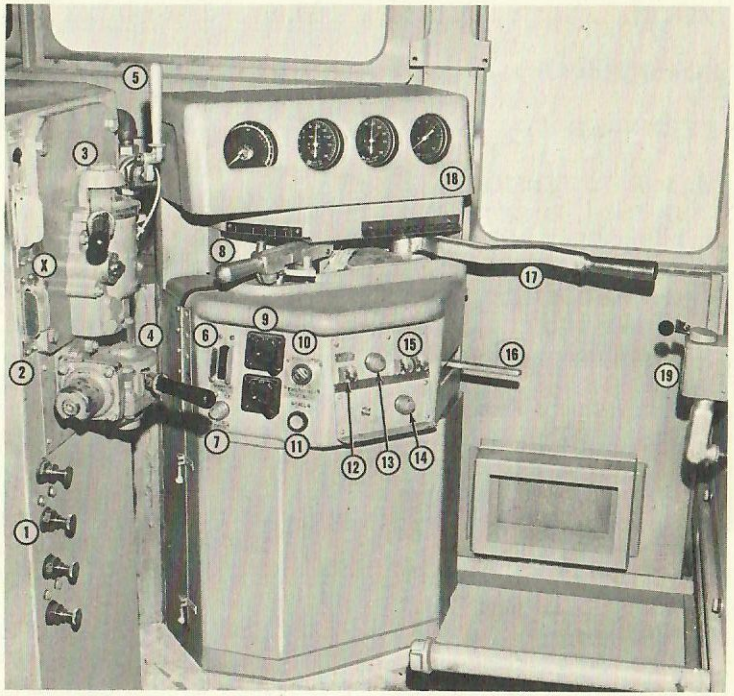


Fig. 1 (E-13526)

1 Bell ringer and window wipers
2 Air regulating valve (back of brake stand)
3 Automatic brake valve
4 Independent brake valve
5 Horn valve
6 Generator-field circuit breaker
7 "PCS OPEN" light
8 Selector handle
9 Headlight switches
10 Emergency shutdown switch
11 Call button
12 Power limit switch
13 Brake warning light
14 Wheel slip light
15 Light switches
16 Reverse handle
17 Throttle handle
18 Instrument panel
19 Sander control
X Optional circuit breakers

Fig. 1. Engineman's position

INTRODUCTION

All of the operating devices, manual and visual, normally used by the engineman during locomotive operation are located near the operator's position. Most of these devices are located either on the master controller, on the air brake stand, or on the engine control panel.

NOTE: *Customer equipment requirements often differ from one railroad to another. Therefore physical locations and appearance of some devices illustrated in this manual may not agree entirely with the equipment furnished to any particular railroad.*

MASTER CONTROLLER

The master controller is a set-up switch used by the operator to control the locomotive. It has a throttle handle, a selector handle, and a reverse handle. These handles control motoring and dynamic braking (if used). Various control switches, circuit breakers, and indicating lights are mounted on the housing of the controller.

Mechanical interlocking between the handles prevents improper operation of any handle. (See INTERLOCKING BETWEEN HANDLES.)

THROTTLE HANDLE (See Figs. 1 and 2)

The throttle handle has an IDLE and eight major and eight intermediate positions or notches. Major notches are registered by a number. Intermediate notches are registered by a dot or 1/2 mark. This handle controls tractive effort when motoring and braking effort when dynamic braking is being used.

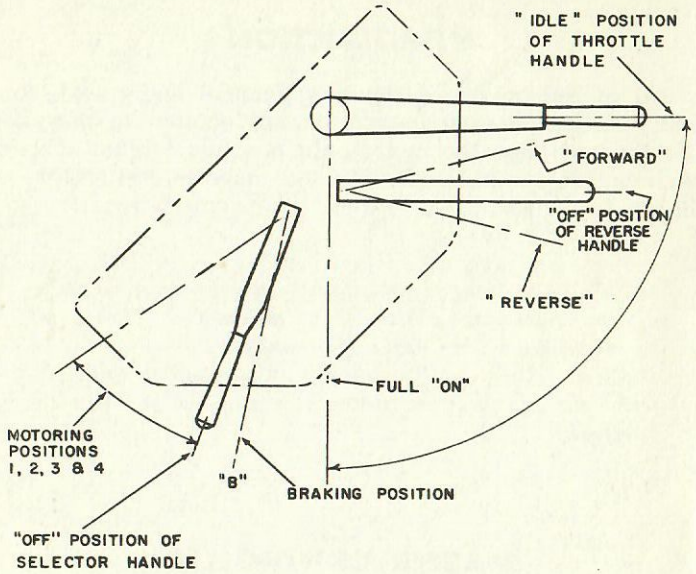


Fig. 2 (E-10102A)

Fig. 2. Master controller handle position

REVERSE HANDLE (See Figs. 1 and 2)

The reverse handle has positions FORWARD, OFF, and REVERSE. It is used to control the direction of locomotive movement.

SELECTOR HANDLE (See Figs. 1 and 2)

The selector handle has positions 4, 3, 2, 1, OFF and B. The numbered positions are used when motoring. Position B is used when in dynamic braking.

In ordinary operation, since all U28 locomotives are equipped with automatic transition, the selector handle may be placed in Position 1 during motoring and left there.

Positions 2, 3, and 4 are used to provide transition for any locomotive units which are in multiple operation and

are not equipped with automatic transition. Handle movement is governed by transition speed of other locomotive units in the consist.

INTERLOCKING BETWEEN HANDLES

Interlock between handles of the master controller is governed in the following manner:

1. The reverse handle can be taken out only when in the OFF position. The selector handle must also be in OFF or 1 and the throttle handle in IDLE position.

2. The reverse handle cannot be moved unless the selector handle is in OFF or 1 and throttle handle is in IDLE.

3. The throttle handle cannot be advanced from IDLE unless the selector handle is in 1, 2, 3, 4, or B.

4. The throttle handle can be moved with the reverse handle in any position.

5. The selector handle cannot be moved into B (braking) unless the throttle handle is in IDLE and the reverse handle is in FORWARD or REVERSE.

DEVICES ON MASTER CONTROLLER HOUSING (See Fig. 1)

The following operating devices are located on the master controller housing:

M.U. Emergency Shutdown Switch

This switch has two positions, STOP and RUN. The normal position is RUN. When this switch is turned to STOP, the diesel engines on all units in multiple unit locomotive consist will shut down.

This switch is provided for emergency use only. Normal shut-down should be made by moving the throttle to

IDLE, the engine control switch (EC) to START, and depressing the STOP button on the engine control panel.

After an emergency shut-down, engine control switch (EC) must be turned to START and engine(s) must be restarted in the normal manner.

Power Limit Switch

This switch has two positions, NORMAL and NOTCH 7. When locomotive units of the same horsepower are operated in the locomotive consist, this switch is ordinarily in NORMAL position.

When the leading unit is slipping excessively, the power limit switch can be moved to NOTCH 7 to reduce power while the trailing units are operating at full power. This will reduce the tractive effort on the leading unit and will usually improve the ability of the locomotive to hold the rail under bad rail conditions.

When other locomotives of lower horsepower ratings are operated in the consist, under certain conditions, this switch must be moved to the NOTCH 7 position unless the locomotives are equipped with automatic power matching control.

Other Switches

a. Front headlight

b. Rear headlight

c. Step lights

d. Gage lights and dimmer control

Call Button

Call button is used to sound alarm bell in all locomotive units.

Wheel-slip Light

Light indicates when a pair of wheels is slipping.

"PCS OPEN" Light

Light indicates that the PCS switch is " open" and has not been reset.

Generator-field Circuit Breaker

The generator-field circuit breaker is ON whenever the locomotive is powered and operating as a lead unit. The breaker may also be used to keep the main generator de-energized when it is necessary to run the engine at speeds higher than idle.

ENGINE CONTROL PANEL

The engine control (EC) panel is located on the rear wall of the operator's cab (See Fig. 3). Mounted on this panel are various other switches, circuit breakers and operating devices used during locomotive operation.

ENGINE CONTROL SWITCH (See Fig. 3)

The engine control switch has two positions, START and RUN. The engine start button is effective only when the EC switch is in the START position.

When the engine is running and the EC switch is in START position, engine speed is held at idle and power cannot be applied to the locomotive. The power plant is said to be "off the line".

When the engine is idling and the locomotive is to be operated, the engine control switch (EC) must be moved to the RUN position.

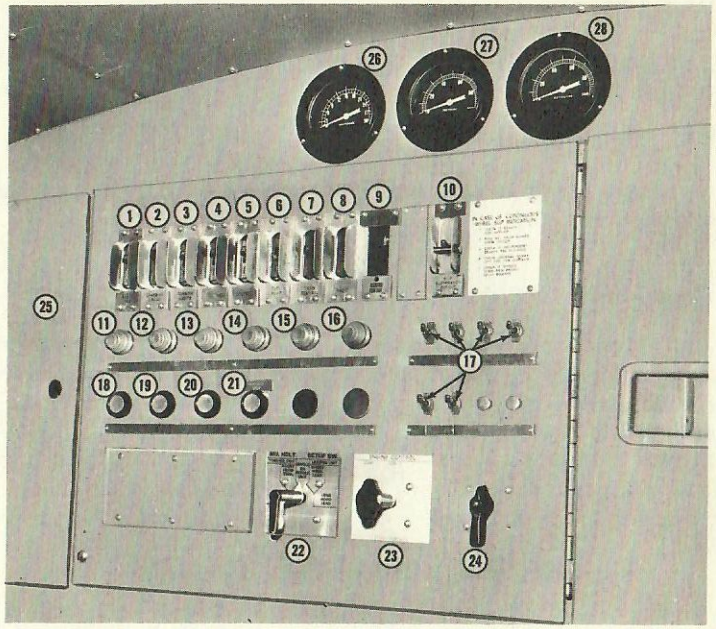


Fig. 3 (E-13527)

1 Engine run
2 Charging circuit
3 Running lights
4 Headlights
5 Control
6 Fuel pump
7 (Optional Equipment)
8 (Optional Equipment)
9 (Optional Equipment)
10 Slip suppression cutout
11 Ground relay trip
12 Hot engine
13 Low oil
14 No battery charge
15 Low water
16 (Optional Equipment)
17 Light switches
18 Ground reset
19 Fuel pump reset
20 Engine start
21 Engine stop
22 M. U. headlight set-up switch
23 Engine control switch
24 Motor Cut-out switch (optional)
25 Battery switch compartment
26 Turbo (intake manifold) air pressure
27 Fuel oil pressure
28 Lube oil pressure

Fig. 3. Engine control panel

ENGINE START AND STOP BUTTONS
(See Fig. 3)

To start the diesel engine, depress the ENGINE START button firmly and hold until the engine starts. To stop the engine, depress the STOP button momentarily.

The engine start button is effective only when the engine control switch (EC) is in the START position.

M.U. HEADLIGHT SET-UP SWITCH (See Fig. 4)

The M.U. headlight set-up switch has five positions. Positioning of this switch is determined by location of the locomotive unit in the consist and whether the front of the locomotive unit is leading or trailing. Switch positions are as follows:

SINGLE OR MIDDLE UNIT: Place switch in this position on any locomotive unit operated singly or on all units, except the leading or trailing unit, when the locomotive consist is made up of more than one unit.

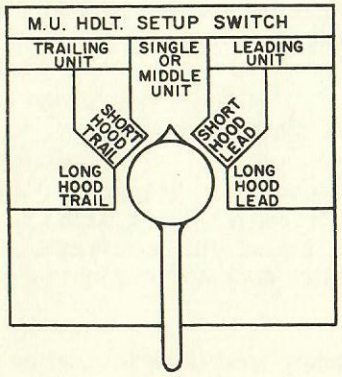


Fig. 4 (E-11960)

Fig. 4. M.U. headlight set-up switch

SHORT HOOD LEAD – LEADING UNIT: Place switch in this position when leading unit is operated with the short hood forward.

LONG HOOD LEAD – LEADING UNIT: Place switch in this position when leading unit is operated with the long hood forward.

SHORT HOOD TRAIL – TRAILING UNIT: Place switch in this position when final trailing unit is connected so its short hood trails.

LONG HOOD TRAIL – TRAILING UNIT: Place switch in this position when final trailing locomotive is connected so its long hood trails.

M.U. BRAKING SELECTOR SWITCH

The M.U. dynamic braking selector switch (when installed) is furnished in several styles depending on the request of a railroad. Position the selector switch according to the directions on the nameplate and according to railroad rules.

The selector switch must be positioned before leaving the terminal and must not be changed even if the engine is isolated enroute.

MOTOR CUT-OUT SWITCH (See Fig. 3)

The motor cut-out switch (if installed) can be used to cut out one or more traction motors. At the same time, power output of the locomotive will be reduced. Operation of the motor cut-out switch does not eliminate a ground fault in a power circuit.

Under emergency conditions the locomotive may be operated for a short period of time with one or more motors cut out. Refer to railroad rules for specific details of operation.

CIRCUIT BREAKERS ON EC PANEL (See Fig. 3)

The following circuit breakers are located on the engine control panel:

1. Charging Circuit – Isolates battery charging generator from the control system.
2. Running Lights (all lights except headlights)
3. Headlights
4. Control
5. Fuel Pump

SWITCHES ON EC PANEL (See Fig. 3)

The following switches are located on the engine control panel:

1. Hood-Engine-Control Compartment Lights
2. Rear Classification Lights
3. Front Classification Lights
4. Front Number Lights
5. Rear Number Lights
6. M.U. Walkway Lights (if equipped)
7. Slip Suppression Cut Out or Wheel Slip Cut Out – Normally this switch is sealed in the "UP" (closed) position. The switch should only be opened as directed by railroad regulations.

GROUND RELAY (See Fig. 3)

The ground relay is furnished to protect the power and control circuits. An indicating light will come on and the bell will ring when the relay has tripped. The reset button must be pushed to reset the relay.

MISCELLANEOUS CONTROLS

In addition to the previously described operating devices, the following additional controls are used by the engineman during locomotive operation:

1. Bell Valve – Mounted on the engineman's brake stand. (See Fig. 1.)

2. Horn Valve – Mounted on the brake stand. (See Fig. 1.)

3. Sander Control – Mounted on the right wall at engineman's position. (See Fig. 1.)

4. Windshield Wiper Valves – Located on the brake stand and over fireman's positions.

5. Hand Brake – Located on outside of nose compartment (low nose locomotive).

6. Emergency Brake Valve – Handle located on helper's side of brake stand. Pulling this handle causes an EMERGENCY brake application and dropping of power.

7. Emergency Fuel Cut-off System – In an emergency any one of three electric push buttons may be depressed momentarily to cut off fuel delivery and shut down the engine. One of these buttons is located on each side of the locomotive platform near the fuel tank. The third button (Engine Stop) is located on the Engine Control Panel and is also used for normally shutting down the engine.

NOTE: *The emergency cut-off button is used to shut down the engine on the local unit only. The emergency shutdown switch on the Master Controller will shut down the engines on all units of the consist simultaneously.*

8. Fuel-trip Reset Button – This button on the Engine Control Panel must be depressed before depressing the engine start button for engine starting and after any emergency fuel cut-off button has been depressed.

9. Cab Heater – Cab heat is regulated by turning the regulating valve behind the brake stand to give the desired heat. Adjust louver control at the base of the heater for suitable air deflection.

CAUTION: *TO PREVENT HEATER FROM FREEZING IN COLD WEATHER, LEAVE VALVES OPEN AT ALL TIMES.*

10. Window Defrosters – The heat for window defrosting is controlled by the same regulating valve which controls cab heat.

11. Cab Ventilation – Cab ventilation is controlled by positioning the hand-operated lever at the base of the cab heater as desired. During long periods of dynamic braking, the lever should be moved to the closed position.

AIR BRAKE EQUIPMENT

The schedule 26-L equipment, arranged for single-end, multiple-unit operation, is used on this locomotive. The principal parts are:

26-C BRAKE VALVE (See Fig. 5)

This brake valve consists of two separate valves: the Automatic brake valve and the Independent brake valve. The automatic valve is designed for regulating brake-pipe pressure to control both locomotive and train brakes. The independent valve will apply and release locomotive brakes independent of the train brakes. The independent valve also controls the release of the locomotive brakes (due to an automatic brake application while in force) without releasing the train brakes.

AUTOMATIC BRAKE VALVE HANDLE (See Fig. 5)

The automatic brake valve handle has six positions:

1. RELEASE (RUNNING) POSITION – This position charges the equipment and releases the locomotive and train brakes after an automatic application. This is accomplished by controlling air flow to the brake pipe as set by handle position of regulating valve (on back of brake stand). The RELEASE position is at the extreme left of quadrant and is the normal position when the automatic brake is not in use.

2. MINIMUM REDUCTION POSITION – This position is located to the right of the RELEASE position where the brake valve handle reaches the first raised portion of the quadrant. With the brake valve handle moved to this position, the minimum service application is obtained which results in a four to six pound brake pipe reduction.

3. SERVICE POSITIONS – This sector for brake valve handle movement is to the right of the MINIMUM REDUC-

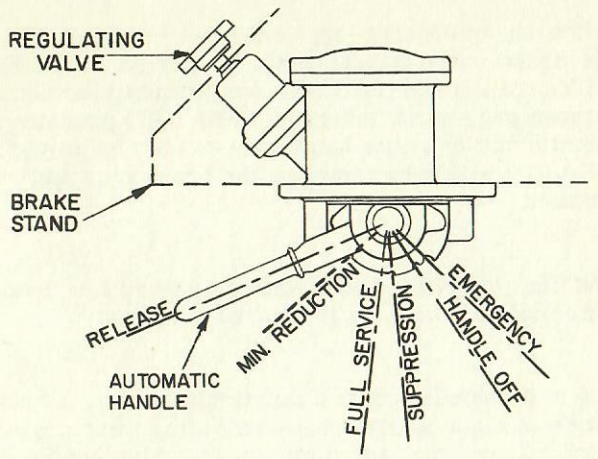


Fig. 5 (E-8924D)

Fig. 5. Automatic brake valve handle positions

TION position. Moving the handle from the left to right in this sector increases the degree of brake application. At the extreme right of the sector, a FULL SERVICE brake application is obtained.

4. SUPPRESSION POSITION – This position is located with the handle against the second raised position of the quadrant, to the right of the RELEASE position. This position provides a FULL SERVICE brake application and in addition, on locomotives equipped with overspeed control and safety control penalty brakes, these applications will be suppressed.

5. HANDLE - OFF POSITION – This position is located by the quadrant notch to the right of the SUPPRESSION position. The handle is removable in this position. It must be placed in this position and removed on trailing units of a multiple-unit consist or on locomotives being towed "dead-in-train."

6. EMERGENCY POSITION – This position is located to the extreme right of the brake valve quadrant. It is used for making a brake valve EMERGENCY brake application.

When an emergency application is received, the Automatic brake valve handle must be moved to the EMERGENCY position and left in this position until the equalizing reservoir gage hand indicates zero ("0") pressure. The Automatic brake valve handle must then be moved to the RELEASE position to recharge the brake pipe and release the brakes.

NOTE: *If equipped with split reduction for penalty application, the penalty control functions.*

When the penalty control functions, a service brake application is made about five seconds after a warning whistle sounds. Leave the Automatic brake valve handle in RELEASE position during the initial reduction of approximately nine lb. for approximately 20 sec. At the start of the second reduction (indicated by a further drop in equalizing reservoir pressure), move the Automatic brake valve handle to the SUPPRESSION position and leave it in this position until the application gage hand shows not less than 125-lb. pressure, then move the Automatic brake valve handle to the RELEASE position.

INDEPENDENT BRAKE VALVE HANDLE
(See Fig. 1)

The Independent brake valve handle applies and releases the brakes on the locomotive consist or releases the brakes on the locomotive unit alone, after an automatic or emergency application.

The Independent brake valve has two positions, RELEASE and FULL APPLICATION, with the application zone between. The brake valve is of the self-lapping type which automatically maintains brake cylinder pressure when the application pressure reaches a value corresponding to the handle position. An Independent brake application can be released only by movement of the handle toward the RELEASE position. An automatic Service or Emergency application can be released on the locomotive consist by depressing the Independent brake valve handle in the RELEASE position.

PILOT CUT-OUT COCK
(See Fig. 6)

This cock, also known as the "double-heading cock", is located on the front of the Automatic brake valve. Push in handle and turn to position for type of service. The OUT position is used when locomotive is operated Trail.

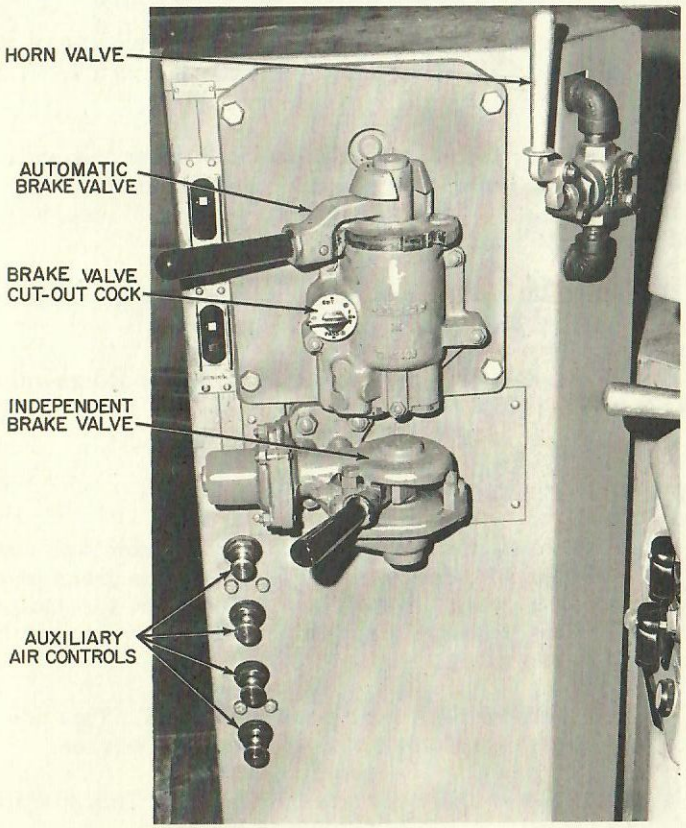


Fig. 6 (E-13528)

Fig. 6. Air and air brake controls

MU-2A VALVE (EQUIVALENT OF ROTAIR VALVE)

This is a two or a three-position valve located on the brake stand. It enables a locomotive equipped with 26-L brakes to be operated in multiple with locomotives having similar or other types brake equipment. Push handle in and turn to change positions.

NOTE: *On some railroads, this device is replaced by a two-position cut-out cock.*

For a normal three position MU-2-A valve (RED) the positions are: LEAD or DEAD, TRAIL-6, and TRAIL-24 or 26.

1. LEAD or DEAD position is used when locomotive unit is operated singly or when it is the lead unit of a multiple-unit consist. Position is also used when locomotive unit is hauled "dead-in-train".

2. TRAIL-6 or 26 position is used to trail a lead locomotive having 6SL or 26L brake equipments.

3. TRAIL-24 position is used to trail a lead locomotive having 24RL brake equipment.

TYPE 26-F CONTROL VALVE

This valve is located in the air brake compartment. When actuated by changes of pressure in the brake pipe, it operates to charge, apply, and release the locomotive brakes. The Release Cap on the control valve can be mounted in two ways:

1. With letters GRA over word RELEASE. This position provides graduated release of automatic brakes.

2. With letters DIR over word RELEASE. This position provides direct release of automatic brakes.

DUPLEX AIR GAGES

The following air gages are located on the gage panel in front of the engineman:

1. Main Reservoir - Equalizing Reservoir – Red hand indicates main reservoir pressure; white hand indicates equalizing reservoir pressure.

2. Brake Cylinder - Brake Pipe – Red hand indicates locomotive brake cylinder pressure; white hand indicates brake pipe pressure.

3. Application-Suppression – Red hand indicates overspeed or safety control "penalty" applications; white hand indicates suppression (if this feature is used).

CUT-OUT COCKS

At specified inspection or maintenance periods, the following manually operated devices are used:

1. Main Reservoir Cut-out Cock – Located on right side of locomotive near the rear main reservoir.

2. Main Reservoir Drain Cocks – One located on the end of each main reservoir unless replaced by automatic drain valves.

3. Air-filter Drain Cocks – Located at rear of fuel tank on some filters. Also, some auxiliary air filters at front of fuel tank may have one.

4. Control-air Cut-out Cock – Located in air brake compartment as part of reducing valve.

5. Control-air Reservoir Drain Cock – Located in air brake compartment on rear wall.

6. Brake Cylinder Cut-out Cocks – Located on right side beneath locomotive platform level (one for each truck).

7. Air Compressor Governor Cut-out Cock – Located near compressor base in radiator cab on right side of locomotive.

8. Bell, Horn and Window Wiper Cut-out Cock – Located in air brake compartment.

9. Cut-out Cocks at Each End of Locomotive (Fig. 7).

a. Brake pipe angle cocks or cut-out cock behind end frame with snow plows

b. Main Reservoir Equalizing

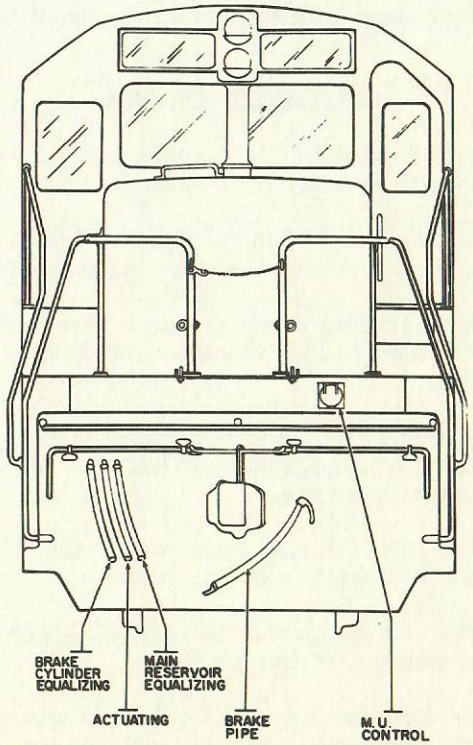


Fig. 7 (E-11821A)

Fig. 7. Locomotive end connections

c. Actuating

d. Brake Cylinder Equalizing (Independent Application and Release)

e. Forward Sand (Pneumatic M.U. Sanding) (right side)

f. Reverse Sand (Pneumatic M.U. Sanding) (left side)

10. Safety Control Cut-out Cock (If used) – Located in air brake compartment. Cuts out safety control feature when closed. (See Air Piping Diagram for inclusion and specific location.)

11. Overspeed Control Cut-out Cock (If used) – Located in air brake compartment. Cuts out overspeed control feature when closed.

12. Slip Suppression Cut-out Cock (If used) – Located in air brake compartment.

13. Dead Engine Cock – Located in air brake compartment.

ADJUSTING VALVES

AIR REGULATING VALVE (FEED VALVE) (See Fig. 5)

The air regulating valve, located on the air brake stand, automatically maintains a predetermined air pressure in the brake system. A clockwise movement of the adjusting handle increases the pressure setting. A counterclockwise movement decreases the pressure setting. Adjust to conform with railroad regulations.

CONTROL AIR REDUCING VALVE

This valve maintains a predetermined normal air pressure in the air pressure supply for operation of the reverser, braking switch, and pneumatic contactors. Clockwise adjustment of the adjusting screw increases pressure. Normal control air pressure is 70 lb.

CIRCUIT BREAKERS (See Fig. 3)

1. Operated like a toggle switch to open circuit manually.

2. Overload in a breaker circuit causes breaker to open the circuit automatically and the toggle moves into center position indicating breaker has tripped.

3. Breaker is reset by moving to OFF, then to ON, after allowing a few minutes for thermal element in the breaker to cool. The breaker should only be reclosed if there is no visible reason for the automatic opening of the circuit. If it trips after reclosing, it should be left open unless instructed otherwise.

COLORED LIGHTS AND BELL

During normal locomotive operation, the bell and all colored lights are off. When locomotive consists of more than one unit, colored lamps will light on affected unit only. Bell will sound on all units.

NOTE: *If troubles occur on two or more units at the same time which cause the alarm bell to ring, turn the EC switch on all affected units to START position before attempting to restart any unit. With the throttle handle on the lead unit beyond IDLE position, it is impossible to start any unit while the alarm bell is ringing.*

LOW-OIL AND LOW-WATER LIGHTS (YELLOW) (See Fig. 3)

A yellow light on the Engine Control Panel will light when either the engine lube oil supply or the cooling water pressure is low.

1. If engine lubricating-oil pressure drops to between 7 to 10 psi at 400 rpm, or between 45 to 52 psi at 1000 rpm, the engine shuts down and a yellow LOW-OIL indicating lamp lights. After engine shuts down, the alarm bell will sound as long as the engine control switch (EC) is in the RUN position.

A yellow LOW-WATER indicating lamp will also come on if the water supply is low.

2. After engine shuts down, move EC switch to START to silence the alarm bell. Check lubricating oil supply on dip-stick. Check for broken or cracked oil lines. Also check water supply at storage tank and check for water piping leaks.

3. To restart diesel engine after fault is corrected:

a. Depress shut-down plunger on engine governor until it clicks and stays in.

NOTE: *The engine governor is equipped with two shutdown plungers, one for low oil and one for low water. Be sure both plungers are reset.*

b. Depress engine start button.

c. After the engine is running, recheck for signs of distress.

d. If condition is normal, put locomotive "on the line" and recheck for signs of distress.

4. If engine fails to start due to LOW-OIL PRESSURE RESET button tripping, do not repeat cranking.

5. If locomotive units are being operated in multiple, then engine on affected unit only, will shut down.

HOT ENGINE LIGHT (RED)
(See Fig. 3)

1. If engine water temperature becomes excessive, the alarm bell sounds and the HOT ENGINE indicating lamp (red) lights.

NOTE: *On some locomotive models, the engine speed will return to Idle for the duration of the HOT ENGINE alarm.*

At first opportunity investigate for cause. When cooling water temperature returns to normal, alarm bell will stop ringing. Turning engine control switch (EC) to START will not stop the ringing of alarm bell or turn off the HOT ENGINE light. If cooling water temperature does not return to normal in a reasonable length of time, shut engine down.

NO BATTERY CHARGE (BLUE)
(See Fig. 3)

If engine is running and engine control switch (EC) is in RUN position and battery charging equipment fails, then NO BATTERY CHARGE lamp (blue) will light and alarm bell will sound. The light will also come on if the engine is not running, but the battery switch is closed. Under this condition, a fault does not necessarily exist.

GROUND RELAY
(See Fig. 3)

1. Ground relay operation:

   a. If a ground occurs in the main power circuits, the ground relay operates to reduce engine speed automatically to IDLE, removes power from traction motors, and sounds the alarm bell.

An indicating light (Ground Relay Tripped) on the Engine Control Panel will light, indicating that a fault has occurred.

   b. If a ground occurs in the control circuits, the ground relay may operate during the engine cranking cycle. Report condition.

2. To reset relay:

   a. Take engine "off the line".

   b. Push in ground relay reset button on engine control panel.

   c. Advance throttle handle. If ground relay stays in, continue normal operation.

NOTE: *On locomotives equipped with a trainline ground relay reset, a tripped relay is indicated by a warning light. To reset the relay, return the throttle handle to IDLE. Wait 15 seconds, then press the reset button. The same reset button is pressed and the same resetting procedure applies when a generator overload relay (GOLR) has tripped.*

3. If ground relay immediately operates a second time, affected unit must not be operated. Unit must either be shut down or, if necessary, engine can be left running by turning EC switch to START. This takes unit "off the line".

PCS SWITCH

The pneumatic control switch (PCS) is operated from the air brake system.

During a safety control "penalty" or emergency air brake application, this switch opens. Engine speed is re-

duced to IDLE and power is removed. The "PCS OPEN" ("PC OPEN") light at engineman's position will light.

To reset the PCS switch automatically:

1. Move throttle handle to IDLE.

NOTE: *If PCS switch has tripped while in dynamic braking, the selector handle must be returned to OFF to reset the circuit.*

2. Move automatic brake valve handle to SUPPRESSION.

3. Depress safety control foot pedal (if used). (When application pipe builds up to normal pressure, PCS will reclose.)

4. Move Automatic brake valve handle to RELEASE.

WHEEL SLIP (WITHOUT AUTOMATIC BRAKING)

If any wheels slip during locomotive operation, normally the following occurs:

1. A reduction in excitation and immediate sanding occurs automatically on the locomotive that is slipping.

2. If wheels continue to slip for more than two or three seconds, wheel slip lamp (on Master Controller) lights.

3. Excitation continues its gradual reduction.

4. When wheel slip is corrected (wheel speed under control), excitation will return to normal and sanding tapers off.

ENGINE OVERSPEED SHUTDOWN (See Fig. 8)

In the event that the engine overspeeds to 1100 rpm, the engine is shut down automatically. After an overspeed-shut-down of the engine, move EC switch to START. Reset the overspeed mechanism by pushing in the knob of the engine overspeed governor (Fig. 8) located on the left side of the engine under the engine control governor. Proceed to start engine as described under STARTING ENGINE. If it overspeeds again, do not restart the engine. If troubles occur on two or more units at the same time which causes the alarm bell to ring, turn the EC switch on all affected units to START position before attempting to restart any unit. With the throttle handle on the lead unit beyond IDLE

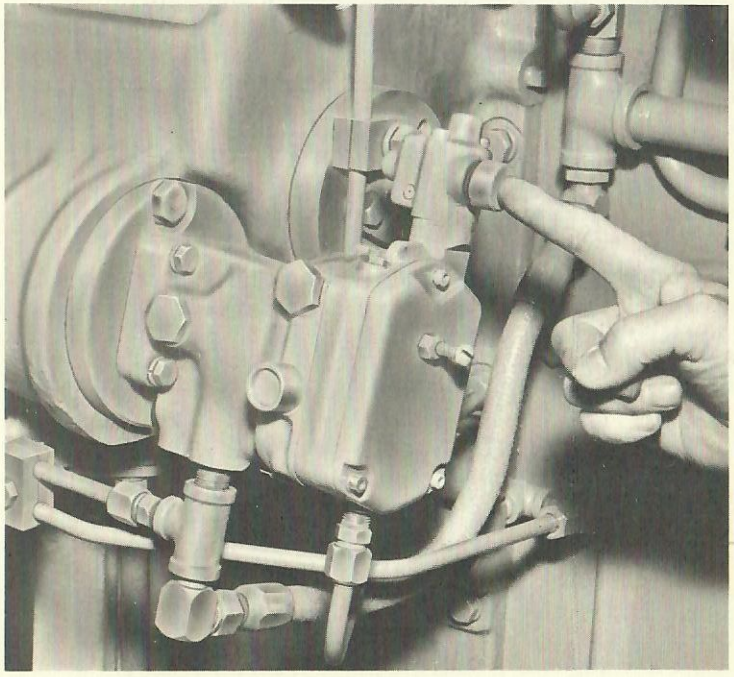


Fig. 8 (E-13028)

Fig. 8. Engine overspeed governor and reset

position, it is impossible to start any unit while the alarm bell is ringing. (During freezing weather, protect engine cooling system according to railroad instructions.)

SAFETY CONTROL FOOT PEDAL

A foot pedal, if equipped, is located at the operator's position. Pedal must be depressed at all times during locomotive operation. If operator's foot is removed from the pedal for more than five seconds, brakes will apply at SERVICE rate. For further description see SAFETY CONTROL.

EMERGENCY SANDING

Emergency sanding (if installed) is automatically applied in forward and reverse directions during all emergency brake applications, for a sufficient time to stop the train. In multiple-unit operation, emergency sanding is applied to all units regardless of whether they are equipped with pneumatic or electro-pneumatic sanding equipment.

LOCOMOTIVE OVERSPEED

When a locomotive equipped with overspeed protection exceeds the maximum permissible speed, an overspeed application is initiated.

1. The overspeed whistle blows.

2. In about five seconds, a penalty brake application is initiated if train speed has not been reduced sufficiently. See air brake regulation for proper procedure.

PRESSURE AND TEMPERATURE GAGES

1. Control Air – Located in air brake compartment. Normal air pressure is 70 psi.

2. Intake Manifold Air-pressure Gage – Located under engine control panel in operator's cab. (See Fig. 3.) Normal reading at FULL ENGINE SPEED and FULL LOAD is 16.5 to 21.0 psi.

3. Fuel Pressure Gage – Located under engine control panel in operator's cab. (See Fig. 3.) Normal fuel pressure at IDLE is 35 psi and at FULL LOAD is 25-30 psi.

4. Lube-oil Pressure Gage – Located under engine control panel in operator's cab. (See Fig. 3.) Normal lube pressure at IDLE is 20 psi and at FULL LOAD is 75-95 psi.

5. Water Temperature Gage – Located on right side of water storage tank. (See Fig. 9.) Normal operating temperature is 170-180 F.

OTHER GAGES

1. Engine Lubricating-oil Dip-stick – One located on each side of engine near lube-oil fill. The stick is marked HIGH and LOW. Proper level with engine idling is between HIGH and LOW.

2. Fuel-oil Sight Glasses – Mounted on both sides of the main fuel tank to indicate level of fuel in the tanks.

3. Cooling Water – A sight glass mounted on side of cooling water supply tank indicates level of cooling water in the system. Markings on tank indicate proper level for conditions. (See Fig. 9.)

WARNING: *TO AVOID PERSONAL HARM FROM WATER BURNS, NEVER REMOVE WATER FILL CAP WHEN WATER LEVEL IS ABOVE "FULL AT IDLE" MARK.*

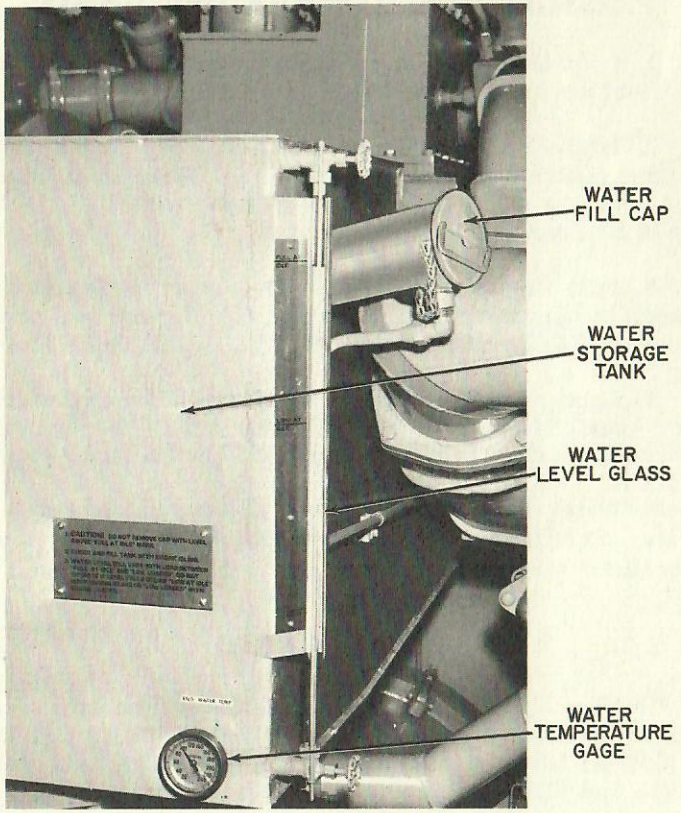


Fig. 9 (E-13529)

Fig. 9. Water storage tank details

4. Compressor Lube Oil (Gardner-Denver Compressor – A gage mounted on the compressor frame indicates oil level. The gage scale is marked ADD (lower red scale), RUN (green scale), EXCESSIVE (upper red scale)). (Westinghouse Compressor – Maintain to RUN level on oil level indicator gage.) (See Fig. 10.)

Fig. 10 (E-11826)

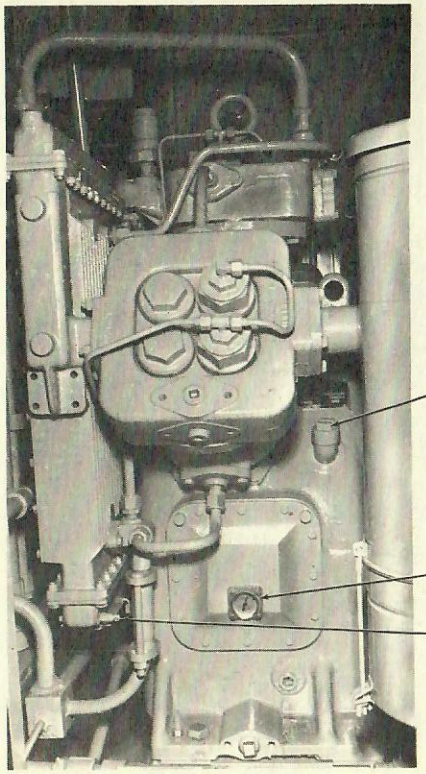


Fig. 10. Air compressor (WABCO)

5. Traction Generator Gear Box – A dip-stick marked EMPTY - ADD - FULL indicates oil level. Proper level is between ADD and FULL with engine stopped. (See Fig. 11.)

6. Fan-gear-unit Oil Level – Maintain oil level near spill-over of fill pipe. (See Fig. 12.)

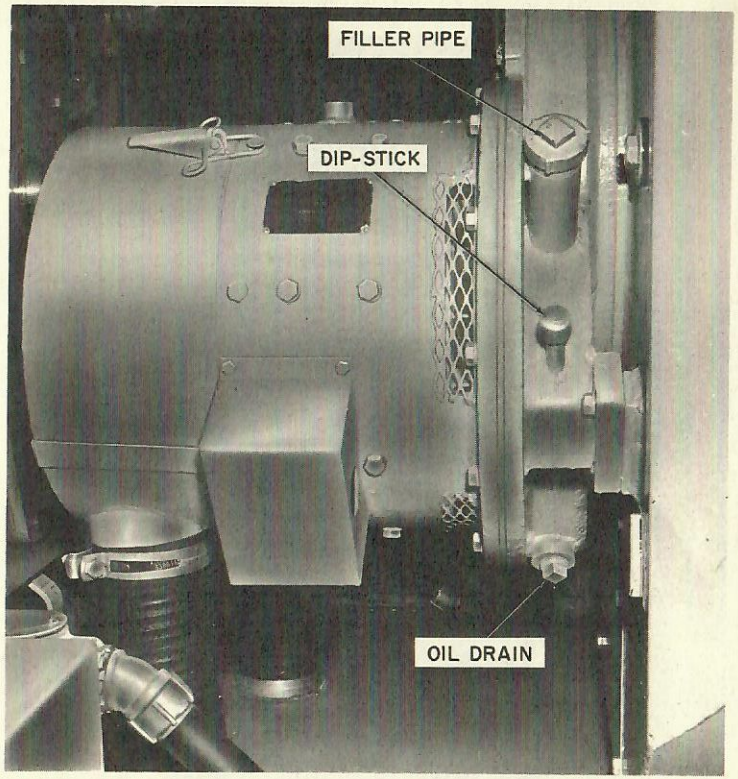


Fig. 11 (E-13029)

Fig. 11. Traction generator gear unit

7. Governor Oil-level Sight Glass – Located on left side of engine near traction generator. (See Fig. 13.) Oil level must be visible between marks on sight glass when engine is running.

Fig. 12 (E-13530)

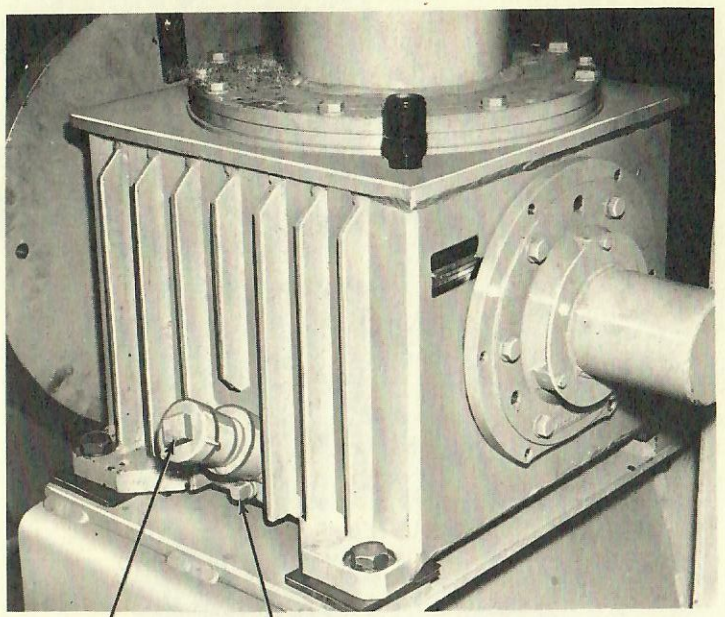


Fig. 12. Fan gear unit

GAGES AND MEASURING DEVICES

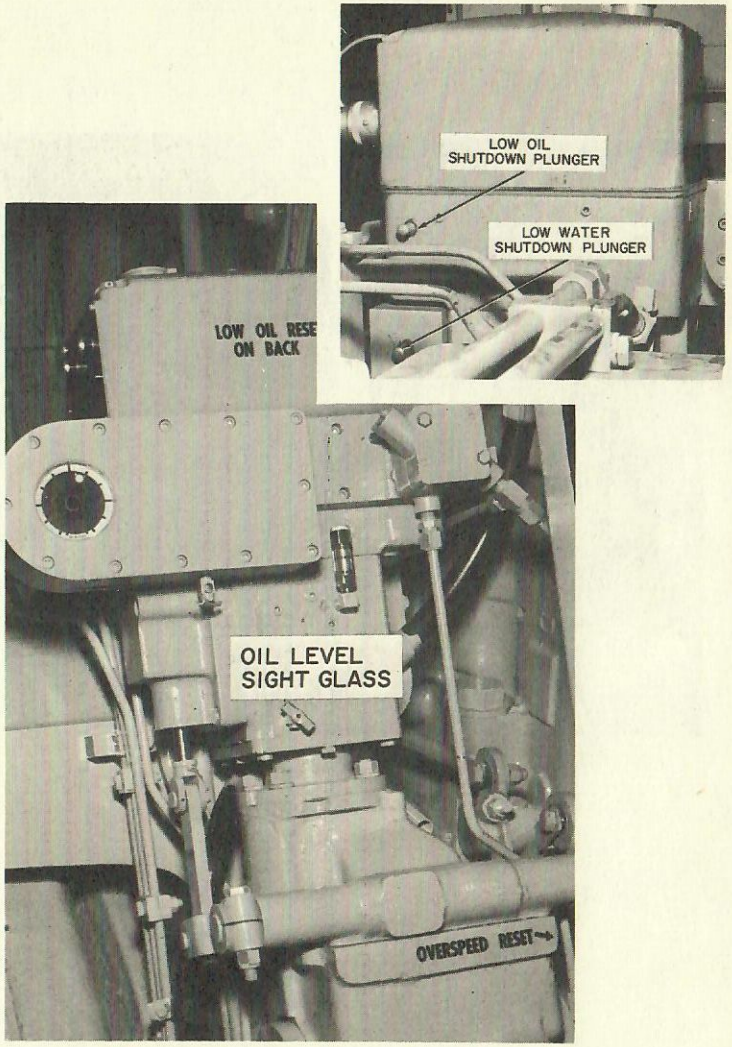


Fig. 13 (E-13030A)

Fig. 13. Engine control governor and low-oil and low-water resets

PREPARATION FOR OPERATION

The following checks and inspections should be made in accordance with railroad rules.

BEFORE BOARDING LOCOMOTIVE

1. Inspect for broken, worn, loose, or dragging parts (brake rigging, brake shoes, wheels, traction motor commutator covers, etc.).

2. Check for leaks from outside piping.

3. Properly position all drain and cut-out cocks.

4. Check proper connection of air hoses and jumper cables (if in multiple with other units).

5. Check fuel supply on fuel tank sight glass.

AFTER BOARDING LOCOMOTIVE

1. Remove rags, tools, etc., from moving parts and electrical equipment.

2. Check diesel engine lubricating-oil supply. Oil level should indicate FULL on measuring gage with engine shut down. A measuring gage (dip-stick) is located on each side of engine and is marked LOW - FULL.

3. Check governor oil supply. Sight glass on governor should be full of oil. After engine is started, oil must be visible between marks on the sight glass. (See Fig. 13.)

4. Check air compressor lubricating oil supply. On Gardner-Denver compressor, proper level is indicated when pointer registers on green portion of scale of oil level indicator. Lower red scale indicates oil must be added. The upper red scale indicates excessive oil. (See Fig. 10.) On WABCO air compressor, maintain oil supply to RUN level on gage.

5. Check cooling water supply. Be sure that water drain valves are closed.

6. Check that fan gear unit oil level is up to spill-over of fill pipe.

7. Check lubricating oil of generator gear unit. Dip stick is marked EMPTY - ADD - FULL. Proper level is between ADD and FULL marks. (See Fig. 11.)

8. Check that diesel-engine overspeed device is reset (Fig. 8).

9. Check that engine barring device is removed from engine.

10. Check that the following air cut-out cocks are open:

a. Air compressor governor

b. Control air

c. Safety control (if used)

d. Bell, horn and window wiper

e. Overspeed control (if used)

11. Check that brake-pipe angle cock is "cut-in" (vertical position).

12. Brake valve pilot cut-out cock (double heading cock) on 26L air brake system should be properly positioned.

13. The MU-2A valve must be positioned according to location of the unit in the locomotive consist and type brake equipment in lead locomotive.

14. Check positions of Automatic and Independent brake valve handles. Automatic brake valve handle should be removed on all trail units and Independent handles in RELEASE if not removable.

15. Move engine control switch to START.

16. Properly position MU headlight selector switch.

17. Properly position MU braking selector switch (if furnished).

18. Check that Throttle handle is in IDLE, Selector handle in OFF, and Reverse handle in OFF.

19. Check that dead-engine cock is in LIVE (or closed) position.

STARTING ENGINE

1. Perform operations as in BEFORE BOARDING LOCOMOTIVE and AFTER BOARDING.

NOTE: *If the engine has been stopped for a considerable period of time, the cylinders should be cleared of fuel or water accumulation before starting the engine.*

Proceed as follows:

a. Apply engine barring-over device and back off compressor relief plugs on left side of each cylinder.

b. Rotate engine at least two complete revolutions by use of the engine barring-over device.

c. Remove barring-over device from engine and tighten all compression relief plugs before cranking.

2. Check that emergency stop switch is in RUN.

3. Close battery switch located beside EC panel in operator's cab.

4. Check that ground relay indicating light is not on. Cause of ground fault must be removed before proceeding.

5. Close the following circuit breakers on the engine control panel:

a. Control Circuit

NOTE: *When starting engines of several locomotives in a multiple unit consist, start engines one at a time. Close control circuit breaker only on one unit. Push fuel pump reset button and allow fuel pump to run a few seconds before starting engine. When all engines are running, close control circuit breaker on lead unit only.*

b. Charging Circuit

c. Fuel Pump

d. Headlights

e. Running Lights

6. Push engine start button on engine control panel and hold until engine starts (approximately 25 seconds).

NOTE: *If proper engine lube oil pressure does not build up within approximately 40 seconds, governor will shut off fuel and prevent engine from starting.*

CAUTION: *DO NOT DISCHARGE BATTERY EXCESSIVELY BY REPEATED ATTEMPTS TO START. IF FIRST TWO OR THREE TRIES ARE UNSUCCESSFUL, RECHECK STARTING PROCEDURE.*

BEFORE MOVING LOCOMOTIVE

1. Turn engine control switch to RUN.

2. Make air brake test and other checks in accordance with railroad regulations.

3. Check main reservoir air pressure according to railroad rules.

4. Check control air pressure. Normal 70 psi.

5. Make independent air brake application. Release hand brake and remove any blocking of the wheels.

6. Allow time for engine cooling water to warm up before moving locomotive in accordance with railroad rules.

FASTER AIR PUMPING

To provide faster air pumping on locomotive, when reservoirs have been drained or after locomotive has been coupled to a train, proceed as follows:

1. Leave generator-field circuit breaker in OFF position.

2. Close control breaker on engine control panel.

3. Leave reverse handle in OFF position.

4. Move selector handle to 1.

5. Move throttle handle to 4th or 5th notch as needed.

NOTE: *If main reservoir air pressure is above 130 pounds and is not rising, increasing engine speed will not raise the pressure.*

MOVING A TRAIN

1. Close generator field circuit breaker on master controller cover.

2. Move reverse handle to FORWARD or REVERSE position, depending on direction of movement desired.

3. Move selector handle to 1.

4. Place foot on safety control foot pedal (if used) and release brakes completely. Several minutes may be required to release brakes, depending on length of train.

5. Advance throttle handle.

6. The throttle handle has full notches and half notches (IDLE up to NOTCH 8), with each successive notch representing an increase in power, or locomotive tractive effort.

Starting a train depends on type, length, weight, grade, condition of rail, and amount of slack in train. This locomotive is designed to have easily controlled tractive effort build-up characteristics, with the tractive effort in each notch limited to definite values as the throttle is moved from the lowest to the highest notch. No harm will be done by moving the throttle beyond notch 4 when starting a train. The engineman can easily control the amount of tractive effort required to start and accelerate a particular train. Speed can be controlled as desired by reducing or increasing throttle position.

STOPPING A TRAIN

Move throttle handle to IDLE and apply air brakes according to railroad regulations. If leaving operator's position after train has stopped, move selector and reverse handles to OFF.

REVERSING LOCOMOTIVE

1. Bring locomotive to a full stop.

2. Move reverse handle to opposite direction.

3. Release brakes.

4. Open throttle.

PASSING THROUGH WATER

Do not exceed two or three mph if there is water over the rails. Do not pass through water that is over 2.5 inches above top of rail.

PASSING OVER RAILROAD CROSSINGS

Do not pass over railroad crossings at full power or traction motor flashover may result. Reduce power by moving throttle handle to 5th notch, or below, while all units are passing over crossing.

WHEEL SLIP (WITH SLIP SUPPRESSION)

When a slip occurs, a light independent air brake application is made automatically. This may be observed by a fast flicker of the needle on the brake cylinder air gage. At the same time, excitation is slightly reduced automatically. Most slips will be corrected by this automatic action.

If bad rail conditions cause the slip to exceed three seconds, then sand is automatically applied to the rail. The wheel slip light will come on at about the same time sanding starts. When wheel slips cannot be controlled by braking and sanding, the excitation is reduced automatically.

If, in the engineman's judgment, the wheel slip is not corrected by the automatic control, it may be necessary to reduce throttle position or apply sand, or both, until wheel slip is fully corrected.

NOTE: *The slip suppression cut-out switch, usually on the EC panel, is normally sealed in the "UP" (closed) position. This switch should only be opened as directed by railroad regulations.*

STOPPING ENGINES

1. Move throttle handle to IDLE.

2. Open GENERATOR FIELD circuit breaker on master controller stand.

3. Move engine control switch to START.

4. Press STOP button, on engine control panel.

5. To shut down all engines when in multiple-unit operation, move MU-ENG EMERGENCY SHUTDOWN SWITCH on master controller to STOP. EMERGENCY SHUTDOWN SWITCH must be in RUN before attempting to start engine.

BEFORE LEAVING LOCOMOTIVE

1. Apply hand brake and release air brakes after uncoupling from train.

2. Leave throttle in IDLE and selector in OFF. Remove reverse handle after moving to OFF.

3. Open all switches and circuit breakers.

4. Close windows and doors.

5. Open battery switch.

6. In freezing weather, precautions must be taken to see that the cooling water does not freeze. See DRAINING COOLING SYSTEM and follow railroad rules for this situation.

SAFETY CONTROL

Safety control (if installed) consists of a foot-pedal operated air valve, whistle, and a cut-out cock. Except when the locomotive is stopped and locomotive brakes are applied, the engineman must keep the safety control foot pedal depressed at all times. This prevents safety control brake application.

After a penalty brake application has occurred, normal locomotive operation is restored in the following manner:

1. Move throttle handle to IDLE.

2. Move automatic brake valve handle to SUPPRESSION.

3. Depress safety control foot pedal. (See Fig. 1.)

4. After application pipe has built up to normal pressure, move Automatic brake valve handle to RELEASE.

NOTE: *Other forms of Safety Control may be provided. See railroad rules for specific procedures.*

Dynamic braking is applied to the locomotive only. A dynamic brake interlock keeps the air brakes on the locomotive from being applied when automatic air braking and dynamic braking are being used. The MU braking selector switch (when installed), must be positioned according to railroad rules.

APPLYING DYNAMIC BRAKING

Applying dynamic braking is done in the following manner:

1. Move the throttle handle to IDLE.

2. Move the selector handle from 1 to OFF to B.

3. Advance the throttle handle slowly to bunch train slack. (Braking is now controlled by the throttle handle.)

4. After the slack is bunched, advance the throttle handle until the desired braking effort is obtained. Observe and correct braking effort during initial period of dynamic brake application.

CAUTION: *PROLONGED OPERATION OF DYNAMIC BRAKING IN 8TH NOTCH AT SPEEDS ABOVE 61 MILES PER HOUR CAN CAUSE INCREASED MAINTENANCE OF TRACTION MOTORS.*

The amount of braking effort obtainable varies with the position of the throttle for the various speeds. Maximum braking effort is obtained in the 8th Notch at speeds of 22 to 30 mph depending on locomotive gearing.

When a locomotive is equipped with variable range dynamic braking, a series of peak braking efforts will occur down to 8 mph.

NOTE: *Wheel-slip warning may occur while in dynamic braking. This indicates that wheels are sliding. Sand is applied automatically to the wheels of the sliding unit. Reduce throttle position until warning stops.*

USE OF AIR BRAKES DURING DYNAMIC BRAKING

When necessary, the automatic air brake may be used in conjunction with the dynamic brake. Automatic air brakes will apply on the train but not on the locomotive. If the Automatic air brake handle is moved to the emergency position, the dynamic brake is removed and brakes on the locomotive as well as those on the train go into emergency application.

The independent air brake *must not* be used during dynamic braking to avoid flat spots on the locomotive wheels caused by sliding.

RELEASE OF DYNAMIC BRAKING

Release dynamic braking in the following manner:

1. Move the throttle handle to IDLE.

2. Move the selector handle from B to OFF to 1.

OPERATING AS A LEADING UNIT

To operate the locomotive as a lead unit of a consist, proceed as follows:

1. Make the necessary preliminary preparations for operation.

2. Test air brake in accordance with railroad rules.

3. Close the generator field circuit breaker.

4. Move reverse handle to the desired direction.

5. Move the selector handle to Position 1. If any trailing units require manual transition, the selector handle for the trailing unit must then be moved to Positions 2, 3 and 4 at locomotive speeds required for transition on these units.

6. When equipped with MU Braking Selector Switch (optional equipment), position the Selector Switch according to railroad rules.

7. Operate locomotive in accordance with operating procedure.

OPERATING AS A TRAILING UNIT

AIR EQUIPMENT SET-UP

1. Make a Full Service application with the Automatic brake-valve handle.

2. Move the brake-valve pilot cut-out (double heading cock) to the OUT position.

3. Move the Automatic brake-valve handle to the HANDLE OFF position and remove the handle.

4. Move the MU-2A valve to suit brake equipment on the leading unit (either TRAIL-24 or TRAIL-26 or 6 positions).

5. Place the Independent handle in RELEASE position.

ELECTRICAL SET-UP

1. Move the Reverser handle to OFF and remove the handle.

2. Place the Selector handle in OFF position. (Leaving the handle in Position 1 of the trailing unit prevents loading when in multiple with some type locomotives.)

3. Open the generator field circuit breaker on the master controller. Leave all breakers in the closed position on the engine control panel (EC) *except the control circuit breaker* and engine run switch if used. Running lights circuit breaker may be positioned as desired.

4. Place the M.U. headlight set-up switch in the proper position.

5. Place M.U. braking selector switch (if installed) in proper position.

CHANGING OPERATING ENDS

To change operating control from the cab of one locomotive unit to the cab of another, proceed as follows:

VACATING UNIT—AIR EQUIPMENT SET-UP

1. Make a Full Service brake pipe reduction.

2. Allow time for all air blowing sounds to stop; then depress the handle of the brake valve pilot cut-out cock and move it to the OUT position.

3. Place the Automatic brake-valve handle in the HANDLE-OFF position and remove; place the Independent brake-valve handle in the RELEASE position.

4. Depress the handle on the MU-2A valve and move it to TRAIL-24, or TRAIL-6 or TRAIL-26 position, depending on the type of equipment used on the lead locomotive unit.

VACATING UNIT—ELECTRICAL SET-UP

1. Move the Reverser handle to OFF and remove the handle.

2. Place the Selector handle in OFF position.

3. Open the generator field circuit breaker on the master controller.

4. Leave all breakers in the closed position on the engine control panel (EC) *except the control circuit breaker* and engine run switch if used. Running lights circuit breaker may be positioned as desired.

5. Move M.U. headlight set-up switch to required position.

OPERATING UNIT—AIR EQUIPMENT SET-UP

1. Insert the Automatic brake-valve handle in the HANDLE-OFF position.

2. Move the Independent brake-valve handle to the full application position.

3. Depress the handle of the MU-2A valve and move it to the LEAD or DEAD position.

4. Depress the handle of the brake-valve pilot cut-out cock and move it to the IN or FRT. or PASS. position as designated by the service in which the locomotive is to be operated.

OPERATING UNIT—ELECTRICAL SET-UP

1. Insert the Reverser handle into the reverser of the Master Controller.

2. Close the generator field circuit breaker on the Master Controller.

3. Close all circuit breakers on the Engine Control Panel (EC).

4. Move M.U. headlight set-up switch to required position.

TO OPERATE WITH OTHER TYPES OF UNITS

If the units of the locomotive consist are geared for differing maximum speeds, do not run at speeds in excess of that recommended for the unit having the lowest maximum permissible speed.

Similarly, do not operate at low speeds long enough to exceed the specified traction motor ratings on any of the units in the locomotive consist. This locomotive, because of its high horsepower per axle, will develop more tractive effort at any given speed than will units of lower horsepower per axle.

On G-E units equipped with automatic power matching control, power is automatically reduced to a lower level under certain conditions when operating at low locomotive speeds. Special operating instructions will be required for this feature.

When the leading unit is slipping excessively, the power limit switch can be moved to Notch 7 to reduce the power on this unit while the trailing units are operating at full power. This will reduce the tractive effort on the leading unit and will usually improve the ability of the locomotive to hold the rail under bad rail conditions.

Units equipped with braking current limiting regulators can be operated in multiple with G-E locomotives in dynamic braking, regardless of the gear ratio or differences in maximum braking current ratings. If some units do not have current limiting regulators, the locomotive consist MUST always be operated so as not to exceed the braking current of the unit having the lowest maximum braking current rating. Special operating instructions will be required for this case.

When a locomotive unit with 26-L equipment is operated in multiple (lead or trailing) with 24-RL equipped units, or with units equipped with brakes of the No. 6 type, the following hose connections must be made:

26-L		24-RL		OR WITH NO. 6
Brake Pipe		Brake Pipe	to	Brake Pipe
M. R. Equalizing Pipe	to	M. R. Equalizing Pipe	to	M. R. Equalizing Pipe
Actuating Pipe	to	Actuating Pipe		
B. C. Equalizing Pipe	to	Ind. Appl. & Rel. Pipe	to	B. C. Equalizing Pipe
Sanding Pipe	to	Sanding Pipe	to	Sanding Pipe

26-L and 24-RL equipped locomotive units can be operated together in any combination.

26-L and No. 6 equipped locomotive units can be operated together in any combination.

With 26-L equipped locomotive leading one or more 24-RL equipped locomotive units, No. 6 equipped units with or without actuating pipe can trail.

Only if it has an actuating pipe, can a unit having No. 6 type equipment be operated between a leading 26-L equipped unit and a trailing 24-RL or 26-L equipped unit.

BRAKE-PIPE LEAKAGE TEST

A brake-pipe leakage test can be performed in the following manner:

With the brake system fully charged and with the brake valve pilot cut-out cock in the IN position, move the Automatic brake-valve handle promptly toward service position until the equalizing reservoir pressure has been reduced 15 psi; then stop and leave the handle in this position.

As soon as the brake-pipe pressure has reduced to the level of the equalizing reservoir pressure (continuous blow from brake-valve exhaust), depress the brake-valve pilot cut-out cock handle and move it to OUT position. Immediately observe the brake-pipe gage and time the pressure drop in accordance with railroad rules.

At the completion of the brake-pipe leakage test, move the brake-valve handle further toward SERVICE position and reduce the equalizing reservoir pressure slightly below the brake pipe pressure. The brake may later be released by returning the brake-valve handle to RELEASE position.

DEAD HEADING (DEAD-IN-TRAIN)

1. Place the Independent brake-valve handle in RELEASE position and the Automatic brake-valve handle in HANDLE-OFF position.

2. Depress the brake-valve pilot cut-out handle and move to OUT position.

3. Depress the handle of the MU-2A valve and move to LEAD or DEAD position.

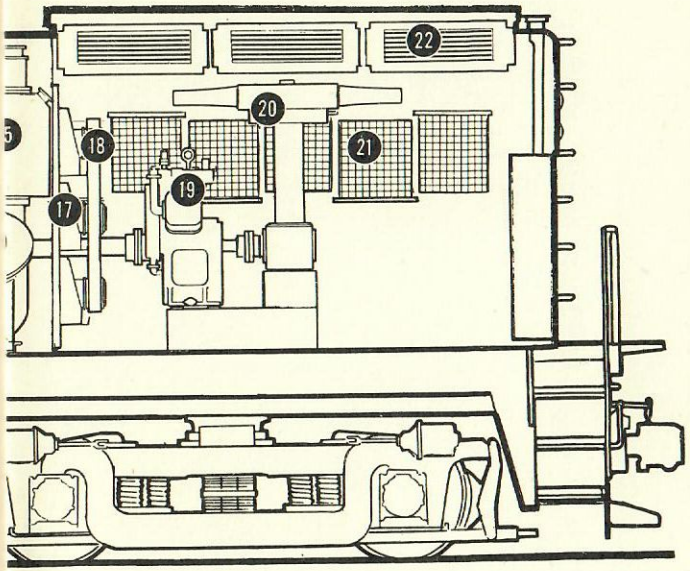
4. Open the dead engine cock.

DRAINING WATER SYSTEM

For weather above freezing, the cooling water system may be drained by opening the main water drain valve on the right side of the locomotive near the base of the lube oil cooler.

For freezing weather, in addition to opening the main drain valve, remove the plug at the base of the water pump and be sure that both cab heater valves are open.

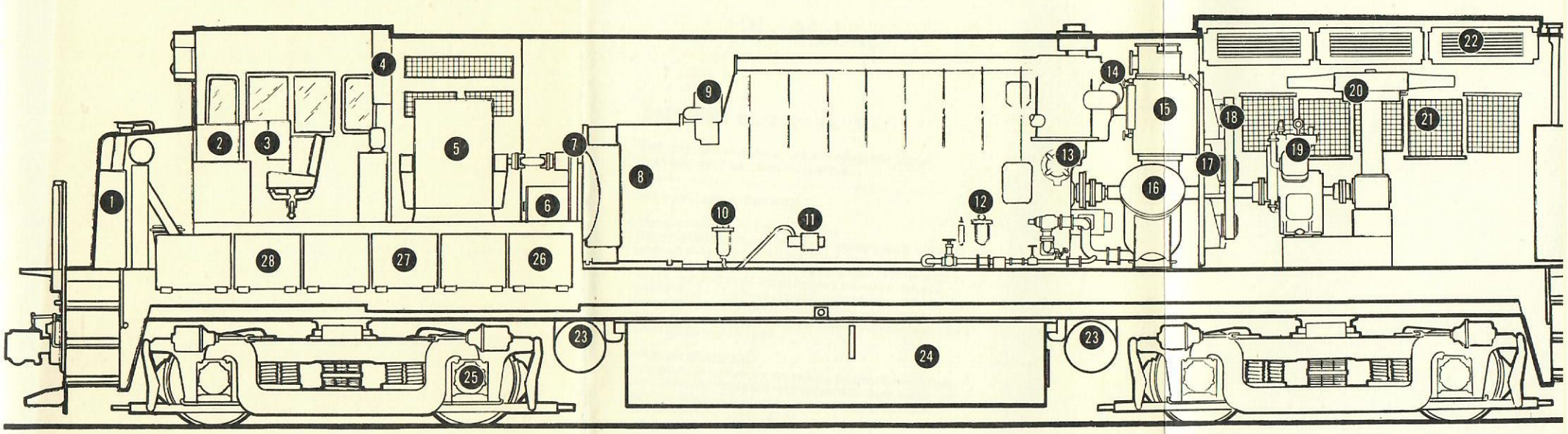
Fig. 14 (E-13533)



Dynamic brake grids (when equipped)
Radiator
Air reservoir
Fuel tank
Axle alternator (one per axle)
Batteries (right side)
Air brake compartment (right side)
Control compartment (left side)

Fig. 14. Apparatus locations

Fig. 14 (E-13533)



1 Sand box
2 Operating controls
3 Air brake controls
4 Engine control panel
5 Equipment blower
6 Auxiliary generator (left side)
Exciter (right side)
7 Traction generator gear case
8 Traction generator
9 Engine control governor
10 Fuel strainer
11 Fuel booster pump
12 Lube oil fill
13 Lube oil strainer
14 Turbocharger
15 Water storage tank
16 Lube oil filter
17 Oil bath air filters
18 Engine primary air cleaners
19 Air compressor
20 Radiator fan
21 Dynamic brake grids (when equipped)
22 Radiator
23 Air reservoir
24 Fuel tank
25 Axle alternator (one per axle)
26 Batteries (right side)
27 Air brake compartment (right side)
28 Control compartment (left side)

Fig. 14. Apparatu